Globes, AEDL, and a Particle-Oriented Model

Testing ways to use AEDL concepts as a universal or standard way to represent other simulations.

The Particle-Oriented (P-O) model provides a mechanism for mapping concepts between the world of physics and computer science, being based in particle-like objects (review in panel#2).

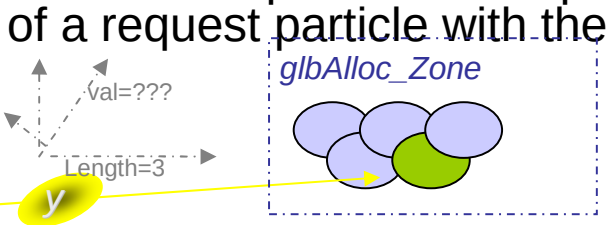
Ex. Defining and Setting Oscillation parameters with model-particles.

In this example a typical Globes code is seen with the data and functions modeled as particles and its reactions-zones respectively:

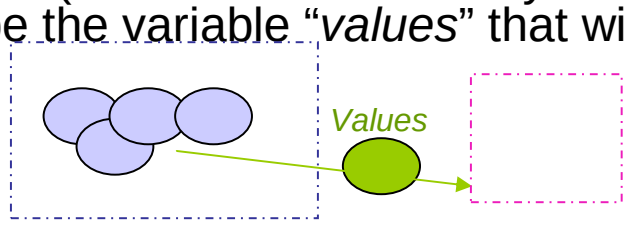
- The *glbAllocParams* process of requesting a part of memory modelled as the collision of a request particle with the memory (composite of particles)

GLOBES code:

values = glbAllocParams();



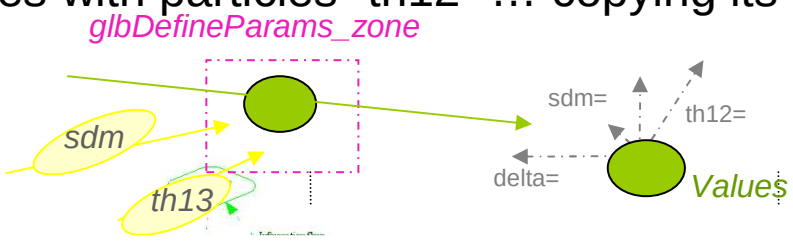
- The allocation process (with access a memory of complex mem particle composite) let escape the variable "*values*" that will hold the params.



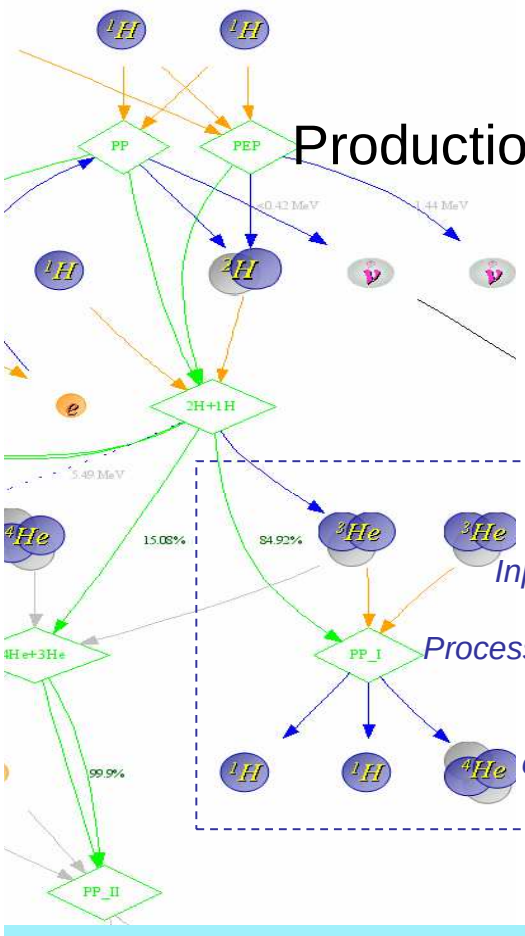
- The particle "values" continues moving and passes through the zone called "glbDefineParams" where it collides with particles "th12" … copying its info.

glbDefineParams(values,th12, th13, th23,delta,sdm,ldm);

...
glbFreeParams(values);



Backwards mapping: particles interactions into computer processes



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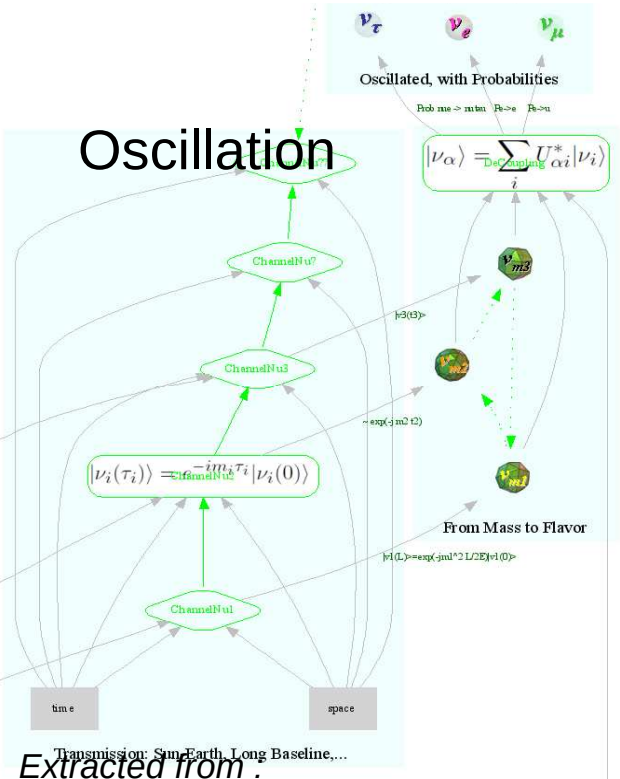
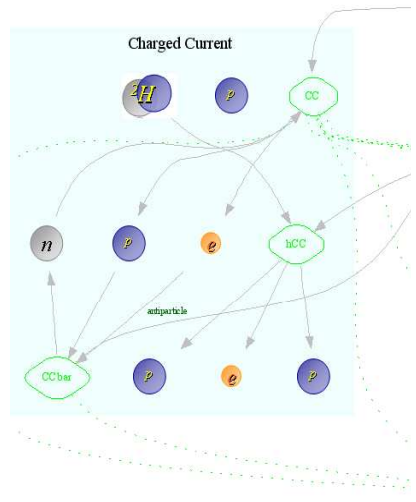


Oscillation



Detection

Extracted from :

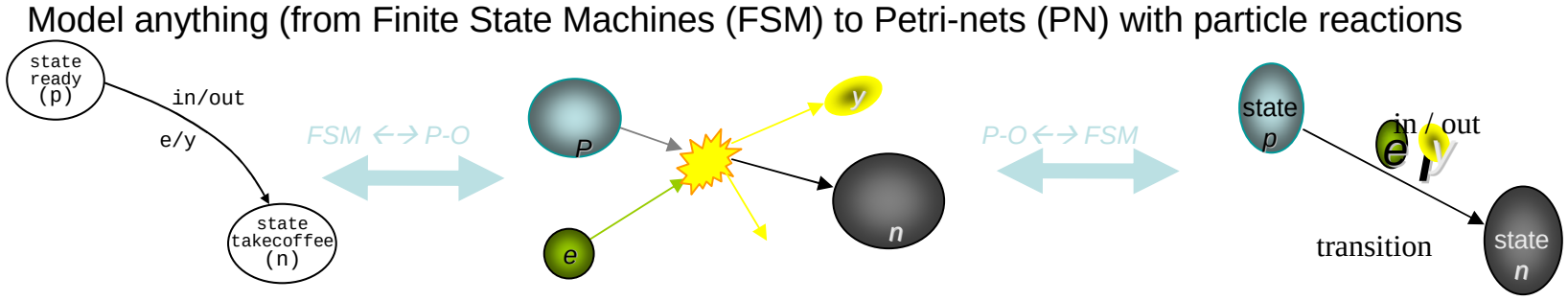
[ND3] Mathematical information & organization of research experiments poster at the NDM'06 Neutrino conference, Paris, September 2006
http://www.lsi.die.upm.es/~jcmartinez/Martinez-P12-Vert-NDM06

Mapping between Globes AEDL and A Particle-Oriented modeling
Martinez, UPM Madrid University & supported by http://Intequanta.biz

"Mapping between Globes AEDL and A Particle-Oriented modeling", Globes Heidelberg, Jan2007

Information Systems as Particles Reactions *REVIEW*

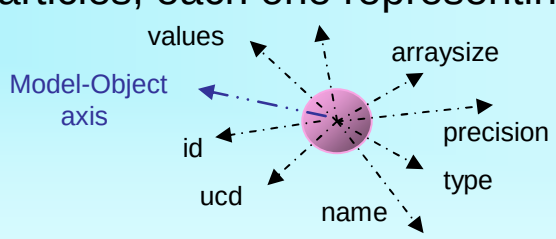
- The firsts computing models using particles collisions are due to E. Fredkin & T. Toffoli in 1981 [FT1] for reversible gates, followed by “The Chemical Reactor” works at MIT [CR2].
- We focus in the mathematical model for generic computing, as it shows an Equivalence between Information-Particles Objects (P-O) and classical data, reviewed here [1][2] :
  - Model anything (from Finite State Machines (FSM) to Petri-nets (PN) with particle reactions



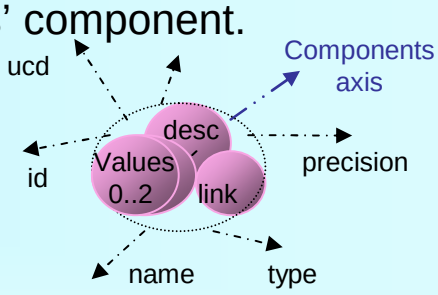
  - Applicable from design to operations as if the systems were composed of modeling particles.
  - The Maths show the bidirectional mapping between the P-O model and the classical models [1]
- Why using particles instead of others (Object Oriented, State Machines, …) ?
  - It introduced Space-Time coordinates into processes and data, aiming to help visualization and also to being able to leverage modeling-geometry and symmetries in order to simplify designs.
  - It maps to UML, also visual, but P-O allows to use of geometry and even create model- conservation laws to simplify designs (as momentum-conservation help calculus in physics).
  - A “particle reactor“, as a compiler or interpreter, handles communicating messages, data parsing & composition, statistical multiplexing,… allowing time to designers for focusing in key functionalities.

The modelling particles can be seen as existing in a many-fold space or as a composite of onedimensional modelling particles, each one representing an axis’ component.

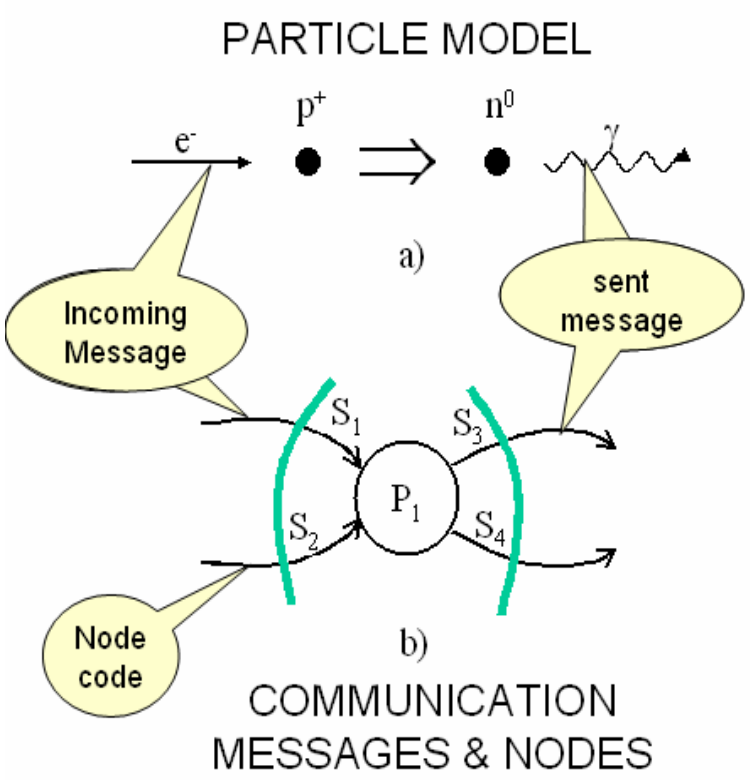
Mathematically 1 particle in a N dimension many-fold is equivalent to 1 object which is the composition of N fundamental particles. A P-O reactor should be able to work with both extremes as well as intermediate views:



Particle seen in Many-fold space



Seen as a particle composition



A *Particle Observation*, or *measurement*,
- Extends what the computational reference framework defines as an event,
- Corresponds to messages, goes beyond a signal and contains all messages fields.

An *observed history* is the set of observations of particle values at different times
- equivalently to a signal or a flow of messages, or conversations between nodes

A particle *Trajectory or path* is the set of space-time coordinates
- It corresponds to timestamps in computing and networks, – not values - along its life history.
- extended to allow the use of geo coordinates

A zone, defined in terms of collisions of particles,
- Equivalent to process in computing
- in networks, it is equivalent to nodes, and some special cases of links, networks and subnets

–[FT1] Conservative Logic, E. Fredkin, T. Toffoli, 1981,

–[CR2] Amorphous computing. H. Abelson, D. Allen, D. Coore, C. Hanson, E. Rauch, G. J. Sussman, and R. Weiss.. Communications of the ACM, 43(5):74-82, May 2000

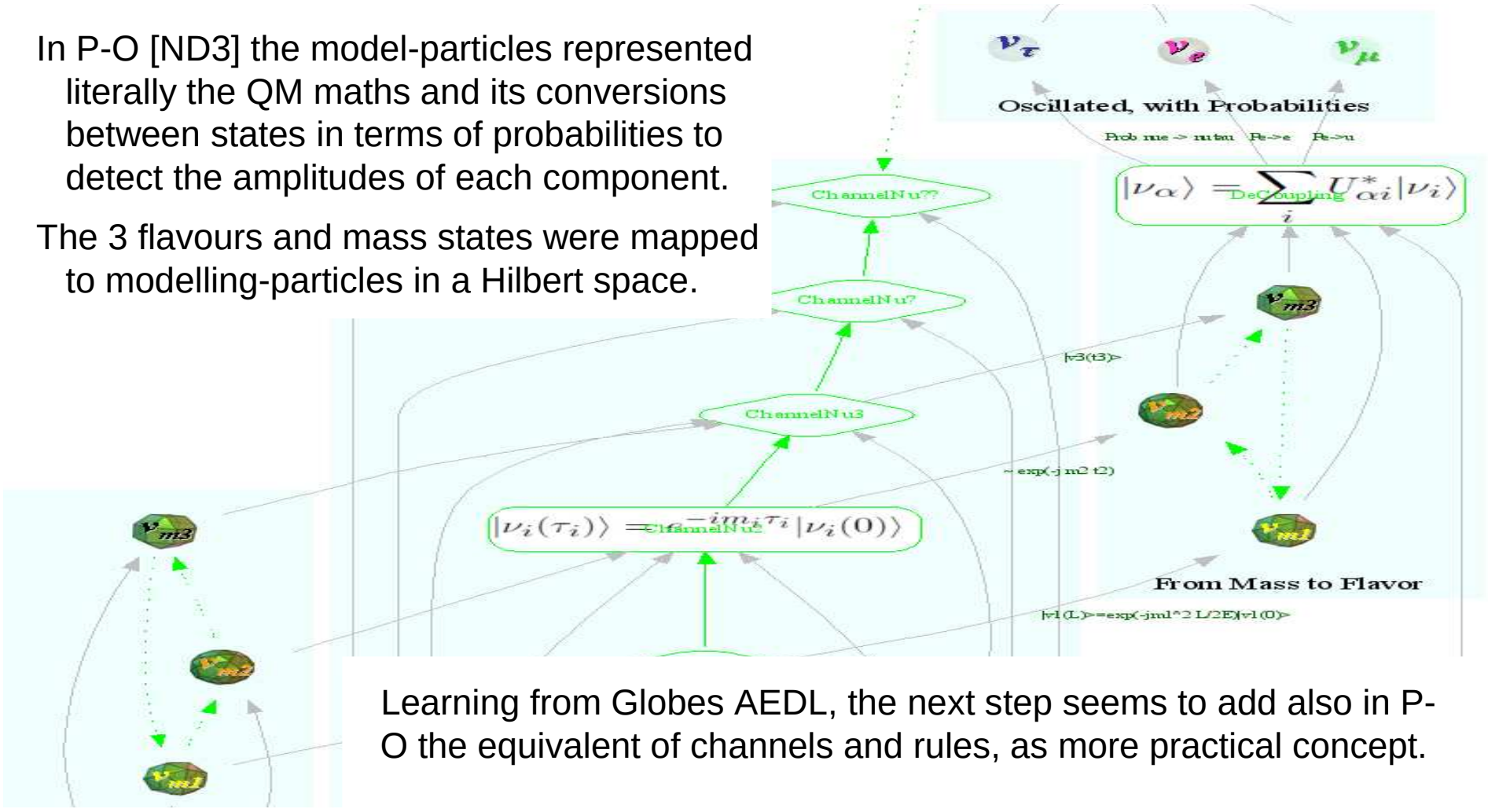
–[1] "Formalized methodology to treat Nature-Inspired Systems mathematically based on particle-dynamics physics”, Martinez, Estebanez., Proc. of Adaptation in Artificial & Biological Systems (AISB), Bristol, April 2006

–[2] “Particle-based Methodology for Representing Mobile Ad-Hoc Networks”, Martinez, Lopez, Estebanez, First International Conference on Integrated Internet Ad-Hoc and Sensor Networks InterSense , Nice, May 2006

Mapping between AEDL and Particle-Objects

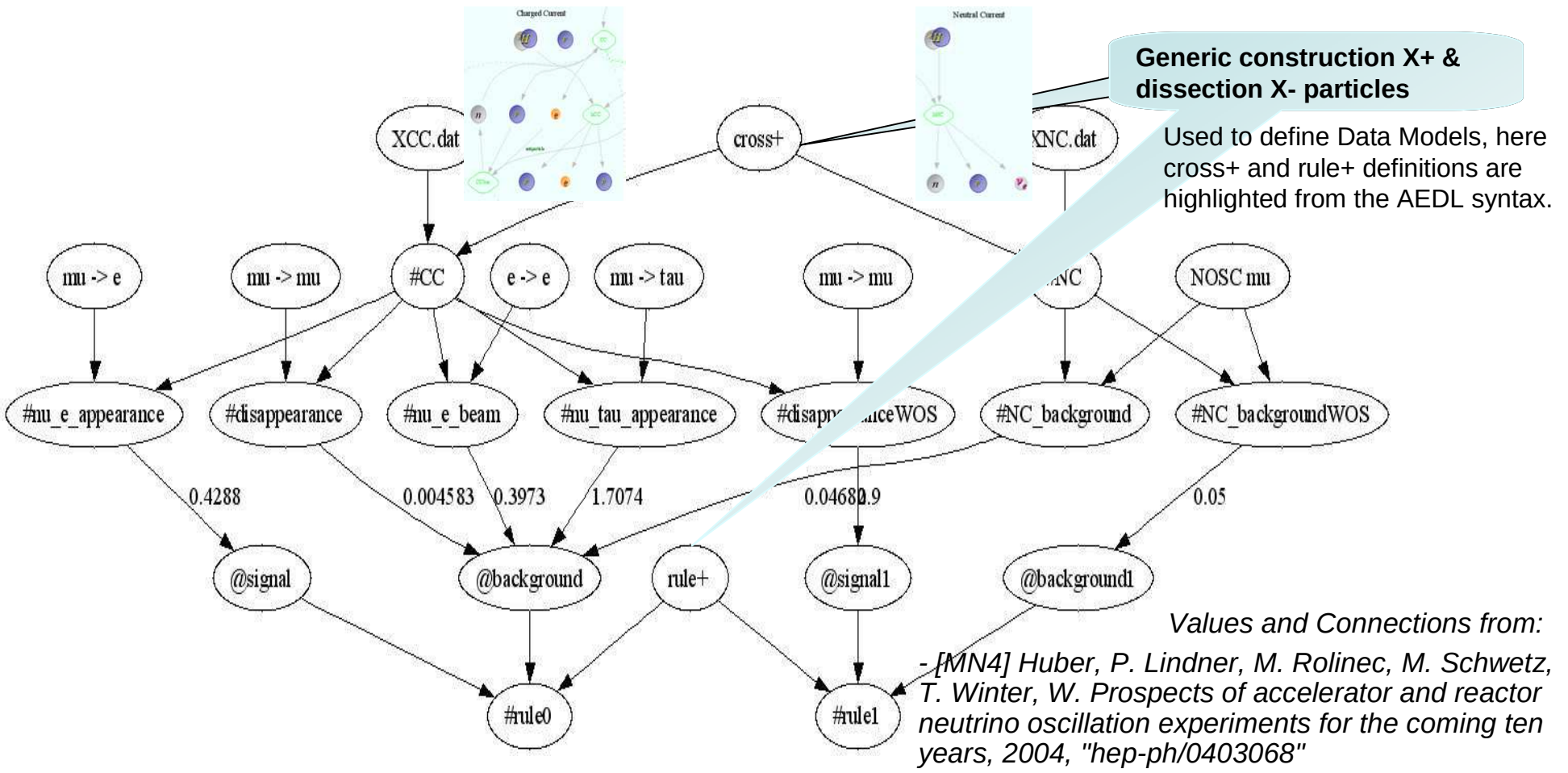
In P-O [ND3] the model-particles represented literally the QM maths and its conversions between states in terms of probabilities to detect the amplitudes of each component.

The 3 flavours and mass states were mapped to modelling-particles in a Hilbert space.



Learning from Globes AEDL, the next step seems to add also in P-O the equivalent of channels and rules, as more practical concept.

In representation and simulations, a goal is to define all reactions in a rule-like language (x y -> u v) using P-O maths for generating code. At this point only the graph trees are automatically generated as in this example of MINOS.glb file [MN4] in the GLOBES site:



Values and Connections from:

- [MN4] Huber, P. Lindner, M. Rolinec, M. Schwetz, T. Winter, W. Prospects of accelerator and reactor neutrino oscillation experiments for the coming ten years, 2004, "hep-ph/0403068"

Looking at easing up the efforts on experiment simulation design and communication, the proposal is to display the AEDL representation of experiments in a graphical way : the present automation was developed under Interquanta.Com's PHY2006 project.

When/Where

- *POSTER:*
- *"Mapping between Globes AEDL & Particle-Oriented modelling", Workshop on Physics and Applications of the GLoBES software, Jan 2007, http://www.mpi-hd.mpg.de/personalhomes/jkopp/glb07/martinez.html*
- *Poster file as sent to J.Kopp pre-presentation*